



The Effects of Water Exercises and Swimming on Physical Fitness of Children with Mental Retardation

by

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The purpose of this study was to determine the effects of water exercises and swimming on physical fitness of children with mental retardation. Nine trainable and 7 educable male children (n = 16) were recruited from a rehabilitation center. The mean ages of the groups were 12.22±0.49 and 14.71±0.52 years, respectively. Training program was applied for 10-week, two times a week for 40 minute each session. Pre- and post-tests measurements were taken for cardiovascular endurance, muscle endurance, speed, static balance, and agility. Results showed that both groups improved significantly (p<0.05) in all dependent variables. Water exercises and swimming appear to be a viable and effective way to improve physical fitness capacity of the children with mental retardation.

Key words: mental retardation, physical fitness, water and swimming exercises

Introduction

Mental retardation (MR) causes important effects on childrens' physical fitness, as well as cognitive activities during life span. Most research in the literature states that children with MR have poor level of physical fitness compared with their nondisabled peers. These studies found that children with MR have a low level of cardiovascular endurance, muscular strength, muscular endurance, running speed, balance, and agility (Barton, 1982; Bertoti, 1989; Fernhall and Pitetti, 2000; Horvat and Franklin, 2001; Pitetti et al., 2001; Vannier and Fait, 1975).

It is well known that children with MR have isolation problems in society what leads to their physical inactivity (Horvat and Franklin, 2001). Some research reports indicate that children with MR achieve very low scores in cardiovascular fitness tests (Vannier and Faith, 1975; Öktem, 1987). In addition, several studies reported a significantly positive correlation between inactive lifestyles and cardiovascular disease. Therefore, physical activities should be established for children with MR, to develop their cardiovascular fitness (Öktem, 1987; Horvat, 1990; Shepherd, 1980).

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Therapeutic effects of swimming and aquatic exercises on physical fitness and well-being have been recognized for people with disabilities (Broach and Datillo, 1996; Lepore, 2000; McHugh, 1995; Ruoti et al., 1994). Furthermore, aquatic exercises are highly recommended for children, in general, as a recreational sport activity (Sherrill, 2006). Although, there was research about the effects of swimming exercises on children without disabilities (Baltaci et al., 1996), there has been no research on children with MR. Therefore, the purpose of this study was to evaluate the effects of a 10-week water exercise and swimming program on physical fitness of children with MR.

Methods

Participants

Nine trainable (Group 1) and 7 educable (Group 2) ($n = 16$) male subjects without multiple disability were recruited from a shelter and rehabilitation center. The mean ages of the groups were 12.22 ± 0.49 years with 36.89 ± 1.27 IQ level and 14.71 ± 0.52 years with a 55.57 ± 2.23 IQ level, respectively. All participants were selected from children without prior physical activity experience. Before the physical fitness tests, subjects were examined by a pediatric cardiologist and permission to participate in these activities were approved by the parents or legal guardians.

Measurements

In this study, data were collected on six dependent variables as pre- and post-test measurements to determine the effects of a 10-week water exercise and swimming program (Vannier and Faith, 1975; Yılmaz et al., 1993; Yılmaz et al., 1994):

1. 25-yard (22.86m) dash: This test measures short distance running speed. Subjects ran 25 yards as quickly as possible, with ready and go commands. At the end of the run, time was measured in seconds with a chronometer.

2. Bent arm hang: A horizontal bar was used for this test. Subjects hold the bar with both hands, using a reverse grip. The hands are shoulders width apart. The subjects bring their head to bar, pressing the bridge of their nose to the bar. He holds this position as long as possible. The number of seconds held in this position is recorded. The purpose of this test is to measure upper extremity strength and endurance.
3. Leg lift: This test measures lower extremity strength and endurance. The subjects lie flat on their backs with their hands clasped behind the neck. The subjects raise their legs, keeping the knees straight till a 90-degree angle is achieved. Subjects do as many leg lifts as possible. The number of leg lifts is recorded during 20 seconds.
4. Thrusts: This test measures agility. The subject takes a squat position with the feet and hands on the mat. At the command, the subjects take their weight upon their hands; then thrusts their legs straight back and then return to the starting position. The number of thrusts is recorded during 20 seconds.
5. Static balance test: This test measures ability to maintain balance in a stationary position. The subjects place their hands on their hips. One leg is then lifted and the foot is placed on the inside of the knee of other leg. Subjects then close their eyes and maintain balance in this position as long as possible. The time is recorded in seconds.
6. 300 yard (274.32m) run-walk: The purpose of this test is to measure cardio-respiratory endurance. The subjects start in a semi-crouch position with the start command. The time is measured in seconds.

Procedure and description of the treatment program

All subjects ($n=16$) participated in a 10-week water exercise and swimming program, for two times a week, 40 minute each session. Pre and post treatment tests were conducted in both groups at the end of 10-week. Training sessions were organized under directions of three physical therapy specialists and

Table 1

Participants' mental and physical characteristics								
	Group 1 (Educable)			Group 2 (Trainable)			Mann-Whitney U Test	
	X	S	Sx	X	S	Sx	U	p
Age (Year)	12.22	1.48	0.49	14.71	1.38	0.52	7,0	0.0079
Weight (Kg)	32.11	3.62	1.21	45.29	9.07	3.43	4.5	0.0021
Height (Cm)	136.56	6.06	2.02	152	13.09	4.95	80	0.0015
IQ	36.89	3.82	1.27	55.57	5.91	2.23	0	0.0002

three swimming trainers. Appendix 1 shows the protocol of the 10-week water exercise and swimming training program.

Statistical Analysis

Data were analyzed using the SPSS statistical software package. Mann Whitney U test was used to compare groups and Wilcoxon Matched Pairs Signed-Rank test was used for within group analysis.

Results

Using Mann Whitney U test, significant differences were found between the groups (Table 1). In general, (it's not so convincing to refer to "significant" results as only being "in general"...I would start the sentence with the word 'Results show that...') results showed that trainable (Group 1) and educable (Group 2) children with MR significantly improved physical fitness levels ($p < 0.05$) in all six dependent variables examined (25 yard dash, upper extremity strength and endurance, lower extremity strength and endurance, agility, balance, and cardiovascular endurance (Table 2).

Discussion

The results of this study show that trainable and educable children with MR improved in all six dependent variables of physical fitness. It is well-known that children with MR have low physical fitness levels compared to children without disabilities (Fernhall and Pitetti, 2000; Horvat and Franklin, 2001; Pitetti et al., 2001). Shephard (1980) stated that this was highly related to low physical activity participation instead of physical disabilities. In addition, Pitetti and Champell (1991) concluded that low physical fitness of MR children was related to the combination of low motivation and insufficient physical activity. Furthermore, research showed that mentally retarded populations have lower motor performance standards compared to populations without disabilities (Yilmaz et al., 1993).

Barton (1982) proposed that maintaining optimal health for mentally retarded populations should emphasize conditioning for better physical fitness levels. Besides, the majority of the literature reviews emphasized the importance of exercise and recreational activities for optimizing the well-being of MR populations, by nurturing physical fitness, motor development (Sherrill, 2006) and self-esteem (Halle et al., 1993; Schurrer and Weltman, 1985; Sim and Stewart, 1984; Yilmaz et al., 1993).

The 25 yard dash test results showed that both educable and trainable children with MR improved

Table 2

<i>Between group differences in all dependent variables of physical fitness</i>								
	Before Training			After Training			Wilcoxon Paired Test	
	X	S	Sx	X	S	Sx	z	p
25 Yard Running Test								
Group1	5.40	0.40	0.13	5.13	0.35	0.12	-2.67	0.0077
Group2	4.96	0.26	0.10	4.58	0.23	0.09	-2.37	0.018
Bent Arm Hang Test								
Group1	3.72	1.87	0.62	6.56	4.29	1.43	-2.67	0.0077
Group2	16.96	19.08	7.21	21.50	18.04	6.82	-2.37	0.018
Leg Lift Test								
Group1	12.00	2.87	0.96	16.67	2.29	0.76	-2.67	0.0077
Group2	13.57	2.76	1.04	17.71	3.25	1.23	-2.37	0.0180
Thrust Test								
Group1	8.78	2.39	0.80	12.11	3.02	1.01	-2.52	0.0117
Group2	8.71	2.50	0.94	12.29	3.35	1.27	-2.37	0.0180
Static Balance Test with Open Eyes								
Group1 (n=9)	8.51	6.89	2.30	15.87	14.35	4.78	-2.67	0.0077
Group2 (n=7)	18.34	21.33	8.06	31.03	26.90	10.17	-2.03	0.0425
Static Balance Test with Closed Eyes								
Group1	2.33	0.97	0.32	4.00	1.91	0.64	-2.67	0.0077
Group2	3.82	2.22	0.84	4.78	2.06	0.78	-2.37	0.018
300 Hundred Yard Run-Walk Test								
Group1	100.11	13.47	4.58	90.0	11.35	3.78	-2.67	0.0077
Group2	86.00	16.89	6.38	76.14	7.73	2.92	-2.37	0.018

significantly ($p < 0.05$) for Group 1, $X = 5.13 \pm 0.12$ s and Group 2, $X = 4.58 \pm 0.09$ s, after 10-weeks of water and swimming exercises. This can be explained as positive effects of these physical activities on running speed. In other studies, Yılmaz et al. (1994) reported significant improvement of results in the 25 yard dash test of 21 educable children with MR (age 9-12, 8.13 ± 0.59 s). Similar results were also reported by Özbaser and Ergun (1994) (6.23 ± 0.6 s).

Bent arm hang test was used to determine the strength and endurance of upper extremities for children with MR. Test results showed that both educable and trainable children with MR improved significantly ($p < 0.05$) for Group 1, $X = 6.56 \pm 1.43$ s and Group 2, $X = 21.50 \pm 6.82$ s after 10-week water and swimming exercises. Studies by Yılmaz et al. (1994) and Özbaser and Ergun (1994) also reported significant ($p < 0.01$) results in bent arm hang test times in educable MR children at 2.98 ± 0.46 s and 4.96 ± 3.5 s, respectively.

Engelman and Morrow (1981) emphasized the importance of strength and endurance of upper extremities on daily life activities of children. Therefore, they suggested that this parameter should be included in the measurement of physical fitness for children. However, the "pull up" test was emphasized to determine upper extremity strength and endurance for children without disabilities in the literature. (Erbaugh, 1990).

Leg lift test was used to measure lower extremity strength and endurance for children with MR. Results show that children with MR in both groups improved significantly ($p < 0.05$) for Group 1, $X = 16.67 \pm 0.76$ Rep/20s. and Group 2, $X = 17.71 \pm 1.23$ Rep/20s. after 10-week intervention. Moreover, in other studies, Yılmaz et al. (1994) and Özbaser and Ergun (1994) found similar leg lift test results on educable MR children of 10.28 ± 0.63 Rep/20s. and $X = 8.93 \pm 3.2$ Rep/20s, respectively.

In this study, the thrust test was used to measure lower extremity strength. Results showed that children with MR in both groups improved significantly ($p < 0.05$) for Group 1, $X = 8.78 \pm 0.80$ Rep/20s and Group 2, $X = 8.71 \pm 0.94$ Rep/20s after 10-week intervention. Yılmaz et al. (1994) reported thrust test results on educable MR children of 6.90 ± 0.48 and Özbaser and Ergun (1994) found it at 6.4 ± 1.3 Rep/s.

Static balance test results show that children with MR in both groups improved significantly ($p < 0.05$) for Group 1, $X = 15.87 \pm 4.78$ s and Group 2, $X = 31.03 \pm 10.17$ s in the balance test with closed eyes

after intervention. Moreover, both groups improved significantly ($p < 0.05$) in the balance test with open eyes for Group 1, $X = 4 \pm 0.64$ s and Group 2, $X = 4.78 \pm 0.78$ s after intervention. The study by Özbaser and Ergun (1994) concurred with our study by reporting static balance test results with open eyes in children with MR at $X = 3.7 \pm 2.7$ s.

In the literature, it was reported that mentally retarded populations have balance problems (Boswell, 1991; Masters et al., 1983). With the widely accepted concept that dynamic and static balance abilities are important components of daily life activities for all children (Figura et al., 1991), improving balance in MR children is of great value. However, Sherrill (2006) stated that children with MR do not learn how to stand on a single leg until around 6-9 years old. Therefore, Boswell (1991) and Sherrill (2006) highly recommended dance and rhythmic activities to develop balance ability for children with MR.

Cardiovascular fitness is an essential component of physical fitness. Research shows that children with MR have lower cardiovascular fitness than their peers without MR (Öktem, 1987; Pitetti and Campell, 1991; Pitetti et al., 2001; Vannier and Faith 1975). In this study, 300 yard run-walk test result showed that children with MR in both groups improved significantly ($p < 0.05$) for Group 1, $X = 90 \pm 3.78$ s and for Group 2, $X = 76.14 \pm 2.92$ s, after 10-week treatment. Yılmaz et al. (1994) reported the 300 yard run-walk test on educable MR children at $X = 120.19 \pm 5.13$ s, while Özbaser and Ergun (1994) reported results of $X = 127.3 \pm 2$ s. Baltaci et al. (1996) reported that swimming exercises had positive effects on cardiovascular fitness of children. Therefore, water and swimming exercises can be an integral part of cardiovascular fitness development of all children in various fitness levels.

Consequently, the present study found that 10-week water and swimming exercises have viable effects on physical fitness of children with MR. Results show that children with MR improved significantly ($p < 0.05$) in all six dependent variables after 10-week treatment. Considering the limitations and sedentary life styles of all children with MR, aquatic exercises can be a good way of developing physical fitness and motor skill development for children with MR. Aquatics provide a very unique environment to all children with disabilities. Children can enjoy many activities in the water without assistance of crutches, wheelchairs, or other devices because of the buoy-

ancy effect of water (Lepore, 2000). Furthermore, swimming exercises strengthen muscles that contribute to body posture, improve joint range of motion, and stimulate muscular relaxation (Skinner and Thompson, 1983). Also, it is reported that aquatic exercises, such as breath control, inhalation and exhalation, promotes development of respiratory function, and oral motor control (Martin, 1983).

At this point, Horvat and Franklin (2001) suggest that children with MR should be provided with more opportunities for different physical activities. Moreover, they emphasize that sedentary life styles, such as inactivity and reduced participation in games and physical activity, should not be tolerated for children with MR. Instead, physical activity

should be encouraged to develop healthier life style habits. Present study was aimed in developing physical fitness of children with MR, via water and swimming exercises. Results show that these exercises have viable effects on subjects' physical fitness. Therefore, children with MR should be encouraged to participate in water and swimming exercises, as well as other sport activities. This study was limited to characteristics of the participants, intervention, tests and measurements that were applied. Further work should address the effects of different settings and physical activities on physical fitness of children with MR.

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Appendix 1

10-Week Water and Swimming Exercise Program

After a 10 min warm up the following water exercise and swimming drills were performed. In addition, a 5 min cool down was conducted.

- 1- Leg kick while sitting on the pool deck (2x1 Min)
- 2- One tour running in the pool (1x1 Min)
- 3- Leg kick with a prone body position on the pool decks (2x1 Min).
- 4- Shoulder abduction and adduction in the water (2x1 Min).
- 5- Leg strokes without arms in back crawl position (2x1 Min.)
- 6- Horizontal shoulder abduction and adduction in the water (2x1 Min.)
- 7- Hoop in the water between pool decks (1x1 Min.)
- 8- Hip abduction and adduction in standing position in the water (1x1 Min.)
- 9- Leg kick with a prone body position in the water (1x1 Min.)
- 10- 390 degree body return with squat position in the water (1x0,5 Min)
- 11- 390 degree body return with standing position in the water (1x0,5 Min)
- 12- Free style swimming with standing position in the water (2x1 Min)

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